PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-191218

(43)Date of publication of application : 13.07.1999

(51)Int.Cl. G11B 7/00

(21)Application number : 09-358787

(22)Date of filing : 26.12.1997

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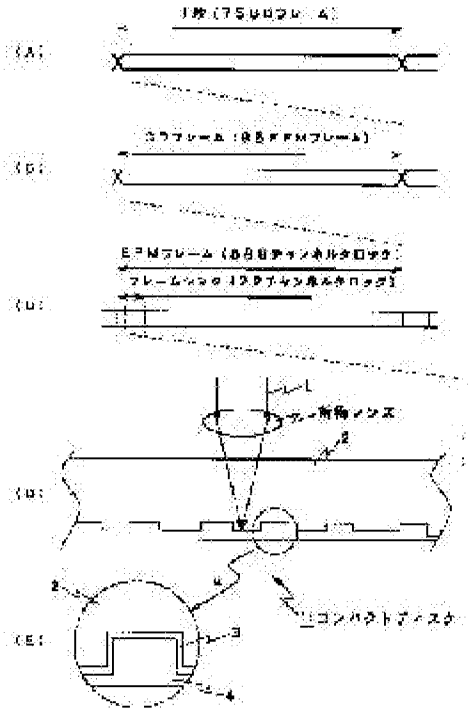
(54) OPTICAL DISK RECORDING DEVICE, RECORDING METHOD OF OPTICAL DISK, AND OPTICAL DISK

(57)Abstract:

PROBLEM TO BE SOLVED: To avoid illegal copying by copying sub-data columns by varying local reflectance of an information recording surface at a position distant from the edge of the pit or mark by a prescribed distance according to the sub-data columns for recording them, concerning pit and/or land of a prescribed length, or mark and/or space of the length or longer.

SOLUTION: A compact disk 1 is made up by forming a reflective recording surface 3 and a protective coat 4 on a disk substrate 2. At this time, it is constituted so that a same film structure as that for a CD-R information recording surface is applied to the reflective recording surface 3, and when it is irradiated with a laser beam L of ≥ a prescribed quantity of light, the reflectance of the reflective recording surface 3 at the laser beam emitting position changes reversely, and the sub-data can be recorded in addition to the main data recorded by repeating bit and land. Thus, it is made difficult to illegally reproduce the main data columns without exerting any influence thereon but it is possible to record the sub-data columns.



* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention is applicable to the preparation device of a compact disk, a compact disk, and a compact disc player, concerning an optical disk recording device, an optical disk recording method, and an optical disc. In this invention, reflection films, such as a pit and a mark, are locally changed to the timing which does not affect the position information on edge.
Therefore, copying refreshable depending on an illegal copy by the optical pickup which reproduces this main data row without affecting it in any way enables it to record the data row of ** on reproduction of the main data rows by a pit sequence etc. difficult.

[0002]
[Description of the Prior Art]Conventionally, after a compact disk carries out data processing of the data row with which record is presented, by carrying out eight-to-fourteen modulation (Eight to Fourteen Modu1ation), The pit sequence of the cycles 3T-11T is formed to the predetermined fundamental period T, and it is made as [record / audio information etc. / by this].
[0003]On the other hand, the record section of administrative data is formed in read in area by the side of inner circumference, and it is made as [reproduce / a desired performance etc. / selectively] by TOC (Table Of Contents) recorded on this record section at it.
[0004]Thus, the numerals which show a maker, a factory, a disk number, etc. are stamped on the inner circumference side of read in area, and the compact disk in which various data is recorded is made as [check / the history of a compact disk, etc. / by viewing / by this].
[0005]
[Problem(s) to be Solved by the Invention]By the way, in such a stamp, it is thought by the ability to check the history of a compact disk that an illegal copy is discriminable by the existence of this stamp. However, this stamp has a fault in which it is difficult to reproduce depending on the optical pickup of a compact disc player by aiming at the check by viewing. When this identifies an illegal copy with a stamp, in order to reproduce a stamp, a reproducing mechanism for exclusive use is needed

separately after all.
[0006]By being recorded by the same method as the usual pit, the numerals recorded by these methods could be reproduced by exfoliating the protective film and aluminum reflection film of a compact disk, and creating La Stampa, and had a problem copied illegally by this.
[0007]By these, without affecting reproduction of the audio information based on a pit sequence in any way, Difficult, if copying refreshable depending on an illegal copy by the optical pickup which reproduces audio information can record the information on **, it will be considered that it can eliminate an illegal copy using this 2nd information.
[0008]This invention without having been made in consideration of the above point and affecting reproduction of the data based on a pit sequence etc. in any way, By the optical pickup which reproduces the data based on this pit sequence, refreshable, And copying depending on an illegal copy tends to propose the optical disc created difficult by the optical disk recording device, the optical disk recording method, and these which can record the data row of **.
[0009]
[Means for Solving the Problem]In [in order to solve this technical problem] this invention, in an optical disk recording device and an optical disk recording method -- a pit more than predetermined length -- and -- or a land. or a mark -- and -- or reflectance of an information storage side is changed locally and a data row of ** is recorded in a part which estranged only prescribed distance from a pit or edge of a mark about a space based on a data row of **.
[0010]moreover -- in an optical disc -- a pit more than predetermined length -- and -- or a land or a mark -- and -- or reflectance of an information storage side changes locally, a data row of ** is recorded, and it is made to become from a pit or edge of a mark about a space in a part which estranged only prescribed distance
[0011]a pit more than predetermined length -- and -- or a land or a mark -- and -- or about a space in a part which estranged only prescribed distance from edge. Reflectance can be changed locally, without affecting timing of this edge in any way, when changing reflectance of an information storage side locally. This records a data row of ** by change of this reflectance, and a data row of ** can be recorded on reproduction of the main data based on a pit sequence etc. without affecting it in any way. The change of reflectance carried out in this way can record a data row of ** refreshable by appearing as light volume change of returned light by an optical pickup which reproduces the main data rows by a pit sequence etc. In a data row of ** which was carried out still in this way and recorded, it can copy only with the device which has a recording system which records a data row of this **. It becomes difficult to copy depending on the technique of removing a reflection film and creating La Stampa. That this copies depending on an illegal copy can record a data row of ** difficult.

[0012]this sets to an optical disc -- a pit more than predetermined length -- and -- or a land or a mark -- and -- or about a space in a part which estranged only prescribed distance from a pit or edge of a mark. When reflectance of an information storage side changes locally and it comes to record a data row of **, a copy can be eliminated effectively.

[0013]
[Embodiment of the Invention]Hereafter, an embodiment of the invention is explained in full detail, referring to drawings suitably.
[0014](1) The lineblock diagram 2 of a 1st embodiment [1st] of an embodiment (1-1) is a time chart which shows the format of the compact disk concerning this embodiment with the section structure of this compact disk. As for this compact disk 1, the disc substrate 2 is created by injection molding, such as polycarbonate using a stamper, like (drawing 2 (D)) and the usual compact disk. The detailed uneven shape on this injection molding and corresponding to a pit and a land in the disc substrate 2 is formed in the information storage side side here. Furthermore, the protective film 4 which the reflection seismogram side 3 which reflects a laser beam in the information storage side side of this disc substrate 2 is formed by vacuum evaporation, and protects the reflection seismogram side 3 continuously by it is formed so that the compact disk 1 may be selectively expanded with the arrow a and it may be shown (drawing 2 (E)).
[0015]By this the compact disk 1 like the usual compact disk, It is made as [record / by repetition of a pit and a land / an audio signal etc.], and the disc substrate 2 is penetrated, the reflection seismogram side 3 is irradiated with the laser beam L, and it is made by receiving the returned light as [reproduce / the audio signal etc. which were carried out in this way and recorded].
[0016]As for a repetition of the pit and land which do in this way here and are formed, like the usual compact disk, 75 CD frames are assigned per second (drawing 2 (A)), and 98 EFM frames are assigned to each CD frame, respectively (drawing 2 (B)). Furthermore, each EFM frame is divided into the channel clock of 588, and sync frame is assigned to 22 channel clocks of the head of them. A pit and a land make one cycle of this one channel clock the fundamental period T, and it is repeated by the length of the integral multiple of this fundamental period, and in sync frame. Furthermore it is made as [create /, respectively / by the cycle 11T], the reflection seismogram side 3 is created in this embodiment by the same membrane structure as the information storage side of CD-R. Thereby, if it irradiates with the laser beam L with more than predetermined light volume, the compact disk 1 is constituted so that the reflectance of the reflection seismogram side 3 in this laser-beam-irradiation position may change reversibly, and is made as [detect / change of this reflectance / light volume change of returned light].
[0017]Drawing 1 is a block diagram showing the finishing device of this compact disk. A disk identification signal is recorded by this finishing device 10, and the compact disk 1 is shipped.
[0018]That is, in this finishing device 10, the spindle motor 11 rotates the compact disk 1 by the conditions of a constant linear velocity by control of the servo circuit 12.
[0019]The optical pickup 13 irradiates the compact disk 1 with a laser beam, and it receives the returned light, and outputs regenerative-signal RF from which a signal level changes according to the light volume of returned light. At this time, by control of the APC (Automatic Power Control) circuit 14, the optical pickup 13 starts the light volume of a laser beam to predetermined timing, and, thereby, changes locally the reflectance of the reflection seismogram side 3 in the compact disk 1.
[0020]The amplifying circuit 15 amplifies and outputs this regenerative-signal RF on a predetermined

profit. The binarization circuit 16 binary-izes the regenerative signal outputted from the amplifying circuit 15 with predetermined reference level, and outputs binary-ized signal BD. PLL circuit 17 reproduces channel clock CK from this binary-ized signal BD.

[0021]The synchronizing pattern detecting circuit 18 detects the sink pattern which appears repeatedly in binary-ized signal BD. Namely, as contrast with drawing 2 shows to drawing 3 (A-1) - (A-4), binary-ized signal BD, A signal level switches corresponding to the pit sequence formed in the compact disk 1, and in the sync frame assigned to the head of each frame, after a signal level rises during the cycle 11T, a signal level falls during the cycle 11T continuously. The synchronizing pattern detecting circuit 18 detects this sync frame by judging the signal level which binary-ized signal BD follows on the basis of channel clock CK by the flip-flop circuit which carried out multi stage connection. Furthermore, the alignment pattern detection pulse SY to which a signal level rises is outputted during the head of each frame, and the period T of one channel clock from the detection result of this sync frame (drawing 3 (C)).

[0022]The alignment pattern prediction circuit 19 is constituted by the ring counter which counts channel clock CK on the basis of the alignment pattern detection pulse SY, The frame pulse FP to which a signal level rises is outputted during the head of each frame, and the period T of one channel clock (drawing 3 (C)). Thereby, even when a defect etc. cannot detect sync frame correctly in the synchronizing pattern detecting circuit 18, the alignment pattern prediction circuit 19 predicts each sync frame, and outputs the frame pulse FP.

[0023]The disk identification signal generation circuit 20 is constituted by the sub-code detector circuit 20A and the read-only memory (ROM) 20B. The sub-code detector circuit 20A reproduces here the sub-code information included in binary-ized signal BD by decoding binary-ized signal BD. further -- a disk -- an identification signal -- a generation circuit -- 20 -- this -- a sub-code -- information -- containing -- having -- a part -- a second -- a frame -- depending -- a hour entry -- from -- a part (AMIN) -- a second (ASEC) -- a hour entry -- alternative -- outputting .

[0024]The hour entry of a part (AMIN) and a second (ASEC) is sub-code information provided in the standard of the compact disk 1, and shows the position of the data on the compact disk 1 here. That is, the hour entry of a part (AMIN) can express with a minute unit the data recorded on the compact disk 1, for example, can take the values from zero to 74. The hour entry of a second (ASEC) specifies further finely the position of the minute unit defined by a part (AMIN) by a second bit, and takes the values from 0 to 59.

[0025]The read-only memory 20B holds disk identification signal ED, and outputs a part (AMIN) to be outputted from the sub-code detector circuit 20A, and the data which made the hour entry of the second (ASEC) the address and held it. Disk identification signal ED is constituted by the information etc. which control the ID information set up as a peculiar thing for every disk, the information concerning a plant, the date of manufacture, and copy good / failure, and a synchronized signal, an error correcting code, etc. showing the beginning of a disk identification signal are contained here. The read-only memory 20B holds disk identification signal ED with bit data, and outputs 1-bit disk identification signal ED to the address of 1 by the hour entry of a part (AMIN) and a second (ASEC).

Thereby, the read-only memory 20B outputs 1 bit [per second] disk identification signal ED.
[0026]The modulation circuit 21 starts the control signal MX of APC circuit 14 to predetermined timing according to this disk identification signal ED, starts the light volume of a laser beam momentarily by this, and changes the reflectance of the compact disk 1 locally.
[0027]Namely, as shown in drawing 4, in the modulation circuit 21 the M sequence generation circuit 23, It is constituted by two or more flip-flops and IKUSUKURUSHIBUOA circuits by which cascade connection was carried out, After setting an initial value to the flip-flop of these plurality by the timing corresponding to change of the hour entry of a second (ASEC), synchronizing with the frame pulse FP, transmit the set contents one by one, and. The logic 1 and the logic 0 generate random-number-data MS of the M sequence which appears in same probability by returning by predetermined interstage. Thereby, M sequence signal MS serves as a series of the pseudo-random number which repeats the same pattern with the cycle corresponding to 1 bit of disk identification signal ED.
[0028]The IKUSUKURUSHIBUOA circuit 24 receives M sequence signal MS and disk identification signal ED, and outputs this exclusive OR signal. Namely, when disk identification signal ED of the IKUSUKURUSHIBUOA circuit 24 is the logic 0, An exclusive OR signal is outputted with the logical level of M sequence signal MS, and when disk identification signal ED is the logic 1 contrary to this, the exclusive OR signal which reverses the logical level of M sequence signal MS is outputted. The IKUSUKURUSHIBUOA circuit 24 will modulate disk identification signal ED with an M sequence random number by this.
[0029]Cascade connection of the flip-flops 22A-22P is carried out, and the frame pulse FP is inputted into the flip-flop 22A of the first rank. These flip-flops 22A-22P transmit this frame pulse FP one by one synchronizing with channel clock CK.
[0030]OR circuit 25 receives an output from the 5th step of flip-flop 22E, and the flip-flop 22P of the final stage which becomes in the 16th step among these flip-flops 22A-22P, and outputs these logical sum signals. By this, if sync frame starts OR circuit 25 and the period for five cycles of channel clock CK passes, If a signal level rises, and sync frame starts only 1 channel clock cycle T and the period for 16 cycles of channel clock CK passes, only 1 channel clock cycle T will output pulse signal WP with which a signal level rises. The period to write and when the signal level of this pulse signal WP rises in carrying out, It is 1 channel clock cycle T of the center of each of the pit of the cycle 11T which forms a sink pattern, and the land of the cycle 11T, and corresponds to the position which estranged only sufficient distance from a pit and both the edge of the land, respectively.
[0031]AND circuit 26 outputs the exclusive OR signal outputted from the IKUSUKURUSHIBUOA circuit 24, and an AND signal with this pulse signal WP as the light control signal MX of APC circuit 14 (drawing 3 (D)).
[0032]APC circuit 14 (drawing 1) switches the light volume of a laser beam to the light volume at the time of record from the light volume at the time of reproduction according to this light control signal MX. The light volume at the time of record is sufficient light volume to change the reflectance of the reflection seismogram side of the compact disk 1 here.
[0033]The system control circuit 28 is constituted by the computer which controls operation of this

finishing device 10 whole, The optical pickup 13 is made to seek on the basis of the sub-code detected in the sub-code detector circuit 20A, and above-mentioned disk identification signal ED is recorded about the predetermined region of the compact disk 1.

[0034]The finishing device 10 is by this with the center of the pit of the cycle 11T which forms a sink pattern, and a center with the land of the cycle 11T, The light volume of a laser beam is started according to disk identification signal ED modulated by random-number-data MS, and additional recording of disk identification signal ED is carried out (drawing 3 (E-1) and (E-2)). Therefore, when additional recording of disk identification signal ED has not been carried out in the compact disk 1, When additional recording of disk identification signal ED is carried out in this way on these pits and lands to regenerative-signal RF by the signal wave form saturating to about 1 constant value being obtained (drawing 3 (F-1)), a pit and near the center of a land, Regenerative-signal RF with which a signal level is locally changed according to the characteristic of the reflection seismogram side 3 will be obtained (drawing 3 (F-2)). As for the compact disk 1, disk identification signal ED is played on the basis of change of the signal level of this regenerative-signal RF.

[0035]Drawing 5 is a block diagram showing the compact disc player which plays this compact disk 1. In this compact disc player 30, the spindle motor 32 rotates the compact disk 1 by the conditions of a constant linear velocity by control of the servo circuit 33.

[0036]The optical pickup 34 irradiates the compact disk 1 with a laser beam, and it receives the returned light, and outputs regenerative-signal RF from which a signal level changes according to the light volume of returned light. A signal level will change here corresponding to the pit where this regenerative-signal RF was recorded on the compact disk 1. At this time, the signal level of regenerative-signal RF will change in the compact disk 1 according to change of the reflectance by disk identification signal ED by being formed so that reflectance may change with records of disk identification signal ED locally. However, when only prescribed distance is estranged and reflectance is changing locally from the edge of these pits and a land about the pit and land of the cycle 11T, The timing to which the signal level of regenerative-signal RF crosses the reference level for binary identification in these pits and a land is maintained by the same timing as the case where reflectance is not changing at all.

[0037]By these, the binarization circuit 35 binary-izes this regenerative-signal RF with predetermined reference level, and creates binary-ized signal BD. Since change of the local reflectance in the compact disk 1 in carrying out to write becomes in the pit which is the cycle 11T, and the center of a land, change of this local reflectance will be detected in binary-ized signal BD.

[0038]PLL circuit 36 reproduces the channel clock CCK of regenerative-signal RF by operating on the basis of this binary-ized signal BD.

[0039]The EFM demodulator circuit 37 reproduces the regenerative data corresponding to the eight-to-fourteen modulation signal S2 by latching binary-ized signal BD one by one on the basis of the channel clock CCK. Furthermore, after the EFM demodulator circuit 37 carries out the EFM recovery of this regenerative data, it carries out the DEINTA reeve of the signal of 8 bitwises which divided and generated this demodulated data by 8 bitwises on the basis of sync frame, and outputs it to the ECC

(Error Correcting Code) circuit 38.
[0040]Based on the error correcting code added to the output data of this EFM demodulator circuit 37, ECC circuit 38 carries out error correction processing of this output data, and, thereby, reproduces and outputs the audio information D1.
[0041]The digital-to-analog-conversion circuit (D/A) 39 carries out digital-to-analog-conversion processing of the audio information D1 outputted from this ECC circuit 38, and outputs audio signal S4 which becomes with an analog signal. At this time, the digital-to-analog-conversion circuit 39 will stop the output of audio signal S4, if this compact disk 1 is judged to be what is depended on an illegal copy by control of the system control circuit 40.
[0042]The system control circuit 40 is constituted by the computer which controls operation of this compact disc player 30. The system control circuit 40 controls the whole operation a priori to access the predetermined region of the compact disk 1, When it judges whether it is what the compact disk 1 depends on an illegal copy based on disk identification signal ED outputted from the disk identification signal regenerative circuit 41 and is judged as what is depended on an illegal copy, stop control of the output of audio signal S4 from the digital-to-analog-conversion circuit 39 is carried out.
[0043]The disk identification signal regenerative circuit 41 decodes and outputs disk identification signal ED from regenerative-signal RF.
[0044]Drawing 6 is a block diagram showing this disk identification signal regenerative circuit 41 in detail. In this disk identification signal regenerative circuit 41, the synchronizing pattern detecting circuit 43 latches binary-ized signal BD one by one on the basis of the channel clock CCK, and detects a sink pattern by judging that continuous logical level. Furthermore, the synchronizing pattern detecting circuit 43 outputs the frame pulse FP to which a signal level rises during the period T of one channel clock which each frame starts on the basis of this detected sink pattern.
[0045]After the M sequence generating circuit 45 initializes an address to predetermined timing by control of the system control circuit 40, Stepping of the address is carried out one by one by the frame pulse FP, a built-in read-only memory is accessed, and the M sequence random number data MZ corresponding to M sequence random-number-data MS which this generated with the finishing device 10 is generated.
[0046]The analog digital conversion circuit (A/D) 47 carries out analog-to-digital-conversion processing of the regenerative-signal RF on the basis of the channel clock CCK, and outputs an 8-bit digital regenerative signal. The inversion circuit (-1) 48 reverses and outputs the polarity of this digital regenerative signal.
[0047]The selector 49 carries out the selected output of the digital regenerative signal by which a direct entry is carried out from the analog digital conversion circuit 47, and the digital regenerative signal which reverses the polarity inputted from the inversion circuit 48 according to the logical level of the M sequence random number data MZ outputted from the M sequence generating circuit 45. That is, the selector 49 chooses and outputs the digital regenerative signal by which a direct entry is carried out when the M sequence random number data MZ is the logic 1, and when M sequence random number data is the logic 0 contrary to this, it chooses the digital regenerative signal by which

polarity reversals were carried out. Thereby, this selector 49 will play the logical level of disk identification signal ED modulated by M sequence random-number-data MS with the data of a multiple value, and outputs regenerative data RX by the data of this multiple value.

[0048]The pit central detector circuit 50 is constituted by the OR circuit which receives the prescribed output of 16 steps of flip-flops by which cascade connection was carried out, and these flip-flops like the modulation circuit 21 in the finishing device 10. The pit central detector circuits 50 are a center of the pit of the cycle 11T, and a center of the land of the cycle 11T by transmitting the frame pulse FP one by one with these flip-flops, and only 1 channel clock cycle T outputs center-section detecting-signal CT to which a signal level rises.

[0049]The sub-code detector circuit 51 supervises binary-ized signal BD on the basis of the channel clock CCK, and decodes sub-code information from this binary-ized signal BD. Furthermore, the sub-code detector circuit 51 supervises the hour entry of this decoded sub-code information, and whenever this hour entry changes for 1 second, it outputs 1-second detection pulse SECP a signal level rises SECP.

[0050]The adding machine 52 is a 16-bit digital adder, and adds and outputs regenerative data RX and the output data AX of the accumulator (ACU) 53. The accumulator 53 comprises a 16-bit memory holding the output data of the adding machine 52, and constitutes an accumulation machine with the adding machine 52 by returning the held data to the adding machine 52. That is, the accumulator 53 records the output data of the adding machine 52 by the timing of center-section detecting-signal CT, after clearing the contents held by detection pulse SECP for 1 second. Thereby, the adding machine 52 accumulates the logical value of regenerative data RX reproduced by the selector 49 for every (7350 inter-frame) second of the hour entry using sub-code information, and outputs the accumulated AX.

[0051]The binarization circuit 54 is the timing to which detection pulse SECP rises for 1 second, binary-izes the output data AX of the accumulator 53 with a predetermined reference value, and outputs. Regenerative data RX of disk identification signal ED played by the selector 49 by this is changed into disk identification signal ED of a binary.

[0052]ECC circuit 55 carries out error correction processing of disk identification signal ED with the error correcting code added to this disk identification signal ED, and outputs.

[0053](1-2) In the composition beyond operation of a 1st embodiment, the disc substrate 2 is created by the manufacturing process of the compact disk 1 concerning this embodiment by the stamper which the Mother disk was created by the usual mastering device, and was created from this Mother disk. Furthermore the reflection seismogram side 3 and the protective film 4 are formed in this disc substrate 2, and the compact disk 1 is created (drawing 2). Thereby, the pit and land by length of an integral multiple of the basic length corresponding to the predetermined fundamental period T in the compact disk 1 are repeated, and digital audio signals etc. are recorded.

[0054]At this time, if the same membrane structure as the information storage side of CD-R is applied to the reflection seismogram side 3 and it irradiates with the laser beam L with more than predetermined light volume by this, the compact disk 1, The reflectance of the reflection seismogram

side 3 in this laser-beam-irradiation position changes reversibly, and in addition to the main data recorded by the repetition of a pit and a land, it is constituted so that additional recording of the data of ** can be carried out.

[0055]Thus, the created compact disk 1, In the finishing device 10 (drawing 1), a predetermined region is played by control of the system control circuit 28, and disk identification signal ED is recorded on this predetermined region so that playback of the digital audio signals recorded by the repetition of a pit and a land may not be affected at all.

[0056]That is, in the finishing device 10, regenerative-signal RF obtained from the optical pickup 13 is changed into binary-ized signal BD by the binarization circuit 16, and a sink pattern is detected from the binary-ized signal of a synchronizing pattern detecting circuit 18 smell lever. The timing of a start of these pits and a land is detected about the pit and land of the cycle 11T with the longest length among the pits and lands which were formed in the compact disk 1 by this.

[0057]In the alignment pattern prediction circuit 19 which furthermore continues, the frame pulse FP to which a signal level rises in the timing of a start of a sink pattern is generated, Even when binary-ized signal BD is not correctly reproduced by the defect etc. by this, the timing of a start is detected by right timing about the pit and land of the cycle 11T.

[0058]Furthermore in the modulation circuit 21 (drawing 4), this frame pulse FP is transmitted one by one with the flip-flops 22A-22P, The 5th step and the output from the 16th step of flip-flop are compounded by OR circuit 25, and, thereby, 1 channel clock cycle T of the center portion of a pit and 1 channel clock cycle T of the center portion of a land are detected about the pit and land of these cycles 11T.

[0059]These are interlocked with and a sub-code is reproduced in the sub-code detector circuit 20A (drawing 1), The information which pinpoints a playback position by the part (AMIN) and a second (ASEC) is detected from this sub-code, and disk identification signal ED is outputted from the continuing read-only memory 20B corresponding to the information which pinpoints these playback positions. By outputting disk identification signal ED which held disk identification signal ED by bit information, and the read-only memory 20B was accessed by the information on a part (AMIN) and a second (ASEC), and held at this time, Disk identification signal ED is outputted by the 1 bit [per second] very low bit rate.

[0060]In the M sequence generation circuit 23, synchronizing with the frame pulse FP, M sequence random-number-data MS which the logic 1 and the logic 0 generate in same probability is generated, and disk identification signal ED is modulated by this M sequence random-number-data MS in the IKUSUKURUSHIBUOA circuit 24. Furthermore in AND circuit 26, the gate of the output of this IKUSUKURUSHIBUOA circuit 24 is carried out by the output of OR circuit 25, According to disk identification signal ED modulated by M sequence random-number-data MS by this, the control signal MX with which a signal level rises by each center portion of the pit of the cycle 11T and a land is generated.

[0061]The light volume of a laser beam is risen by this control signal MX, the reflectance of the reflection seismogram side 3 changes locally, a mark is locally formed in each center portion of the pit

of the cycle 11T, and a land by this, and, as for the compact disk 1, disk identification signal ED is formed.

[0062]In the pit and land of the cycle 11T, such a mark by being formed in a center portion, In the regenerative signal which changes according to this pit and land, these pits and the signal level corresponding to each edge of a land are held by the case where a mark is formed, and the case where the mark is not formed at all at an equal signal level. Disk identification signal ED which becomes by the data of ** is recorded without this affecting playback of the main data based on a pit and a land in any way.

[0063]That is, if the wavelength of NA and a laser beam is placed for the numerical aperture of the optical system which plays the data based on this kind of pit sequence with lambda, the light spot of the diameter D1 expressed by a following formula will be formed in the information storage side of the compact disk 1. The diameter D1 is the half breadth in light spot here.

[0064]

[Equation 4]

$$D1=\frac{1.22\cdot\lambda}{NA} \quad \cdots\cdots (4)$$

[0065]If only the distance D1 is estranged and a mark is formed from the edge of order by this, in light spot, a mark and edge will be scanned simultaneously. On the other hand, the position information on edge sets the average level of regenerative-signal RF as a threshold, it is the timing to which the signal level of regenerative-signal RF crosses this threshold, and this timing corresponds to the timing to which the center of light spot crosses edge. In this timing, when the optical beam is not irradiating with the mark simultaneously, it is held identically to the case where the timing which crosses this threshold does not form the mark at all.

[0066]In [as the diameter D1 of (4) types is set to one half by this and it is shown in a following formula] the distance D1, Disk identification signal ED which becomes by the data of ** can be played without affecting playback of the main data based on a pit and a land in any way, if only this distance D1 is estranged and a mark is formed from the edge of order.

[0067]

[Equation 5]

$$D1=\frac{1.22\cdot\lambda}{2\cdot NA} \quad \cdots\cdots (5)$$

[0068]The general numerical aperture NA in a compact disc player is the value 0.45 here, and the wavelength lambda is 0.78. It is D= 1.06 when (5) types are solved from a certain thing by [mum]. [mum] It becomes. The compact disk 1 is linear velocity 1.2. It rotates in [m/sec] and the frequency of channel clock CK is 4.3218. More than [by (5) types / distance D1], it means estranging from edge and creating a mark, if only the distance equivalent to 4 channel clock cycles is estranged and a mark is formed from edge since it becomes by [MHz].

[0069]That is, from the edge of a pit and a land, if only distance [/ more than abbreviation cycle 4T] is estranged and a mark is formed, the edge information of the pit similarly detected by light volume

change of returned light and a land and the information by a mark can be separated, and it can reproduce. Disk identification signal ED which becomes by the data of ** is recorded without this affecting playback of the main data based on a pit and a land in any way.

[0070]When the logic 1 and the logic 0 modulated disk identification signal ED by M sequence random-number-data MS which appears in same probability at this time, Change of regenerative-signal RF by change of reflectance is observed like a noise mixed in regenerative-signal RF, and, thereby, disk identification signal ED can be made into observation and discovery difficulty. Furthermore, a copy of disk identification signal ED can also be made difficult.

[0071]To these, in addition, by having assigned 1 bit of disk identification signal ED in a period for 1 second, That is, even if it changes a regenerative signal by a noise etc. by distributing and recording this 1 bit on a 7350(7350= 75x98)CD frame in all, disk identification signal ED is certainly renewable.

[0072]Although the compact disk 1 which did still in this way and recorded disk identification signal ED will be copied about the digital audio signals D1 by a pit sequence depending on the technique of the conventional illegal copy, about disk identification signal ED, copying becomes difficult.

[0073]Namely, in creating an illegal copy identically to this compact disk 1, It is necessary to prepare a disk shape recording medium which it is necessary to record disk identification signal ED by a mark similarly, and the digital audio signals D1 are recorded by pit sequence a priori, and has a reflection seismogram side. It is necessary to prepare this finishing device 10 and a device by same composition. About this disk identification signal ED, it is recordable on copy difficulty by these.

[0074]Namely, in (drawing 5) and the compact disc player 30 the compact disk 1 created by doing in this way, By detecting regenerative-signal RF from which a signal level changes according to light volume of returned light produced by irradiating with a laser beam, A signal level of this regenerative-signal RF will change according to reflectance of the compact disk 1, corresponding to a pit and a land, and this regenerative-signal RF is binary-ized by the binarization circuit 35. Then, after binary identification of binary-ized signal BD is carried out by the EFM demodulator circuit 37, it EFM-gets over, and a DEINTA reeve is carried out, error correction processing is carried out by ECC circuit 38, and, thereby, the digital audio signals D1 are reproduced.

[0075]At this time, a mark from which reflectance changes locally in the compact disk 1 on a pit and a land which are the cycles 11T. And by being formed in a pit and a center of a land which beyond distance corresponding to the cycle 4T estranged from edge (they are the both sides of front edge and back edge), Change of a signal level [/ near / each / the edge by having formed this mark] is prevented, and even if it is the compact disk 1 which recorded disk identification signal ED by this, it becomes possible to play correctly with the usual compact disc player.

[0076]Thus, in playback of the digital audio signals D1 performed the compact disk 1, When a predetermined region is accessed, disk identification signal ED is played from this field a priori and this disk identification signal ED cannot be reproduced correctly, stop control of the digital-to-analog-conversion processing by the digital-to-analog-conversion circuit 39 is carried out as an illegal copy.

[0077]Namely, in playback (drawing 6) of this disk identification signal ED the compact disk 1, In the synchronizing pattern detecting circuit 43, sync frame is detected and the M sequence random

number data MZ corresponding to M sequence random-number-data MS at the time of record is generated in the M sequence generating circuit 45 on the basis of detection of this sync frame.
[0078]Regenerative-signal RF is changed into a digital regenerative signal by the analog digital conversion circuit 47, Regenerative data RX which expresses a logical level of disk identification signal ED with data of a multiple value is played by choosing a digital regenerative signal which reverses this digital regenerative signal or polarity by the selector 49 on the basis of the M sequence random number data MZ.
[0079]In the compact disk 1, this regenerative data RX is accumulated by one second bit by the accumulator 53 and the adding machine 52, and, thereby, the signal to noise ratio is improved. After this accumulation result is binary-ized by the binarization circuit 54 and disk identification signal ED is decoded, error correction processing is carried out by ECC circuit 55, and it is outputted to the system control circuit 40.
[0080](1-3) According to composition beyond an effect of a 1st embodiment, a pit and a land of a sink pattern which become the cycle 11T are detected, By having formed a mark in these pits and a center of a land which were estranged T or more [periodic 4], and having recorded a disk identification signal from edge, Without changing a reflection film of a pit and a land locally to timing which does not affect position information on edge and affecting reproduction of the digital audio signals D1 by a pit sequence in any way, Copying refreshable depending on an illegal copy by an optical pickup which plays these digital audio signals D1 can record a disk identification signal difficult.
[0081]About a pit and a land of a sink pattern which were recorded regularly, a disk identification signal is simply recordable by recording a disk identification signal by a mark using this regularity.
[0082]By assigning and recording 1 bit of a disk identification signal on a pit and a land of a sink pattern assigned in about 1 second at this time, influence of a noise etc. can be avoided and a disk identification signal can be played certainly.
[0083]By becoming irregular with M sequence random number data, and furthermore, recording this disk identification signal, a disk identification signal can be recorded on a noise and discernment difficulty, and a disk identification signal can be made into discovery and analysis difficulty. At the time of playback, influence of a noise can be avoided effectively and a disk identification signal can be played.
[0084]By having formed this mark with length corresponding to the fundamental period T, similarly, a disk identification signal can be recorded on a noise and discernment difficulty, and a disk identification signal can be made into discovery and analysis difficulty.
[0085]By removing influence of a noise which detected a signal level of regenerative-signal RF, decoded a disk identification signal in a compact disc player, accumulated this signal level, and was mixed in a disk identification signal, Disk identification signal ED recorded on a noise and discernment difficulty is certainly renewable.
[0086]** which plays certainly a disk identification signal recorded on discovery and analysis difficulty is made by processing a digital regenerative signal selectively with the M sequence random number data MZ in the selector 49, and playing a disk identification signal.

[0087](2) The 2nd embodiment drawing 7 is a block diagram showing a finishing device concerning a gestalt in operation of the 2nd of this invention. This finishing device 60 detects a pit beyond periodic 9T, and records disk identification signal ED on these pits. In composition shown in this drawing 7, the same composition as the finishing device 10 of drawing 1 attaches corresponding numerals, it is shown and duplicate explanation is omitted.
[0088]Namely, in this finishing device 60 the system control circuit 61, It is constituted by computer which controls operation of this finishing device 60 whole, Operation of the optical pickup 13 is controlled on the basis of a sub-code detected from regenerative-signal RF, and a field set as a record section of disk identification signal ED by this is traced by the optical pickup 13 2 times respectively one by one.
[0089]At this time, the system control circuit 61 switches the trace signal T1 to the logic 1 in the 1st trace in the 2nd trace that continues and scans a part scanned by 1st trace to holding the trace signal T1 in the logic 0. It is for the 1st trace detecting a pit beyond periodic 9T here, and the 2nd trace is for carrying out additional recording of the disk identification signal to a pit beyond periodic 9T from this detection result.
[0090]The or more [9] T pattern detecting circuit 62 detects a pit beyond periodic 9T by detecting pulse width more than channel clock 9T in the 1st trace.
[0091]That is, as shown in drawing 8, the or more [9] T pattern detecting circuit 62 has 13 steps of flip-flops 64A-64M by which cascade connection was carried out, and inputs binary-ized signal BD into the first rank of these flip-flops 64A-64M. These flip-flops 64A-64M transmit input data one by one synchronizing with channel clock CK.
[0092]AND circuits 65A-65C input an output of these flip-flops 64A-64M, respectively, and output an AND signal. At this time, AND circuit 65A about an output outputted from the flip-flops 64A, 64B, 64L, and 64M of a final stage in the first rank, the 2nd step, and the 12th step. When a logical level is reversed and inputted and an output of logic "0011111111100" is obtained by this (i.e., when a logical level corresponding to pit shapes which are the length 9T continues), a logical level of an AND signal is started.
[0093]About an output outputted from the flip-flops 64A, 64L, and 64M of a final stage in the first rank and the 12th step, continuing AND circuit 65B. When a logical level is reversed and inputted and an output of logic "0011111111110" is obtained by this (i.e., when a logical level corresponding to pit shapes which are the length 10T continues), a logical level of an AND signal is started.
[0094]About an output outputted from the flip-flops 64A and 64M of the first rank and a final stage, AND circuit 65C. When a logical level is reversed and inputted and an output of logic "0111111111110" is obtained by this (i.e., when a logical level corresponding to pit shapes which are the length 11T continues), a logical level of an AND signal is started.
[0095]OR circuit 66 will output logical sum signal MD which serves as logic "1", if which pit of the cycles 9T, 10T, and 11T is detected by calculating logical sum of an output signal outputted from AND circuits 65A-65C. By sampling and shaping this logical sum signal MD in waveform by channel clock CK, the flip-flop 67 removes influence of a glitzy noise etc., and outputs the detection pulse NP.

[0096]In the 1st trace or more [9] T pattern prediction circuit 63 by switching operation according to a logical level of the trace signal T1 outputted from the system control circuit 61, About a pit beyond periodic 9T, timing signal EP which records a disk identification signal is outputted in the 2nd trace to recording position information based on this recorded position information.
[0097]Namely, as shown in drawing 9, in or more [9] T pattern prediction circuit 63 the sub-code detector circuit 69, by processing binary-ized signal BD on the basis of channel clock CK, position information on the compact disk 1 currently recorded as a sub-code (a frame (AFRAME) -- a second (ASEC) -- a part (AMIN)) is played. A frame (AFRAME) is the position information which made for 1 second 75 division into equal parts here. The sub-code detector circuit 69 decodes S0 flag (it becomes with an alignment pattern of subcoding) contained in a sub-code, and outputs it as sub-code flag S0FLAG which shows one frame of a sub-code.
[0098]By supervising a logical level which binary-ized signal BD follows on the basis of channel clock CK, the synchronizing pattern detecting circuit 70 detects a sink frame, and outputs the sink frame detecting signal SY with which a signal level rises in timing of a start of each frame.
[0099]The alignment pattern prediction circuit 71 is constituted by ring counter which counts a channel clock on the basis of this sink frame detecting signal SY, Even when a sink frame is not detected by defect etc. by this in the synchronizing pattern detecting circuit 70, the frame pulse FP which does not have lack using sink frame periodicity is sent out.
[0100]The counter 72 is constituted by ring counter which counts up channel clock CK on the basis of the frame pulse FP, and outputs counted value EFMC which becomes by position information which divides inside of one EFM frame into 588 by this. Furthermore, the counter 72 counts up the frame pulse FP on the basis of sub-code flag S0FLAG, and creates counted value CDC which becomes by position information which divides the CD frame of 1 into 98 equally by this.
[0101]Thus, when outputting counted value EFMC and CDC, the counter 72, So that counted value EFMC may become the value 0 to timing to which the frame pulse FP rises when the trace signal T1 is the logic 0 (namely, when it is the trace which is the 1st time), When the trace signal T1 is the logic 1 to counting up continuous channel clock CK (namely, when it is the trace which is the 2nd time), Continuous channel clock CK is counted up so that counted value EFMC may become the value 7 to timing to which the frame pulse FP rises.
[0102]Seven cycles of channel clock CK here corresponding to this value 7 are equivalent to a time delay until it outputs timing signal EP by this counted value EFMC and light volume of a laser beam rises to a laser-beam-irradiation position pinpointed by counted value EFMC. Thereby, in the 2nd trace, the counter 72 counts up channel clock CK so that a part of this time delay and counted value EFMC may progress.
[0103]position information (a frame (AFRAME).) according [the memory 74] to the sub-code detector circuit 69 a second (ASEC) -- a part (AMIN) -- a counter -- 72 -- depending -- position information -- becoming -- counted value -- EFMC -- CDC -- an address -- carrying out -- the detection pulse NP -- recording -- a memory -- constituting -- having -- the trace signal T1 -- responding -- operation -- switching . That is, when the trace signal T1 is the logic 0, the memory 74 records the detection pulse

NP which makes such position information an address and is outputted from the or more [9] T pattern detecting circuit 62 (namely, when it is the trace which is the 1st time). On the other hand, when the trace signal T1 is the logic 1, the memory 74 outputs contents which made such position information an address and held it as a timing signal EP (namely, when it is the trace which is the 2nd time).

[0104]The modulation circuit 75 is similar with the modulation circuit 21 mentioned above about drawing 4, and is constituted. That is, cascade connection of the flip-flop of the number of specified stages is carried out, and the modulation circuit 75 transmits the frame pulse FP one by one a channel clock cycle with these flip-flops. Furthermore, the modulation circuit 75 will generate a timing signal with which a logical level rises only the cycle T of one channel clock, if an output is received from the number of specified stages of these flip-flops and only the cycle 4T passes from edge of a start of this pit in a pit beyond periodic 9T by this.

[0105]Furthermore, the modulation circuit 75 generates M sequence random number data on the basis of timing signal EP, and modulates disk identification signal ED with this random number data. The gate of this modulated result is carried out with a timing signal furthermore generated with a flip-flop, and it outputs as the control signal MX.

[0106]Thereby, the finishing device 60 is made as [record / a disk identification signal] about a pit beyond periodic 9T with which it is satisfied of conditions explaining (5) types.

[0107]That is, in a pit beyond periodic 9T, even if only the cycle 4T is estranged and only the cycle 1T changes reflectance from the start side edge, reflectance can be changed, without affecting position information on order edge in any way. In this pit beyond periodic 9T, there is the feature that occurrence frequency is high, as compared with a pit and a land of the cycle 11T. 1 bit of a disk identification signal can be recorded on many pits by this, and the reliability of the part disk identification signal can be improved.

[0108]In a case where a compact disk to write and which is applied to this embodiment in carrying out is played, A pattern detecting circuit by the same composition as the or more [9] T pattern detecting circuit 62 applied to this finishing device 60 will detect a pit beyond 9T, a signal level of regenerative-signal RF will be detected about this pit, and a disk identification signal will be played.

[0109]According to composition of a 2nd embodiment, a pit beyond periodic 9T is detected, and even if reflectance of an information storage side is changed more nearly locally [in timing which estranged only prescribed distance] than edge of this pit and it records a disk identification signal, the same effect as a 1st embodiment can be acquired. As compared with a 1st embodiment, a disk identification signal is recordable using a pit where occurrence frequency is high, Time to be able to record the part disk identification signal certainly, and assign 1 bit of a disk identification signal if needed can be shortened, and storage density of a disk identification signal can be improved.

[0110](3) The 3rd embodiment drawing 10 is a block diagram showing a finishing device of the compact disk 1 concerning a 3rd embodiment. In this finishing device 80, pit detection processing beyond periodic 9T and additional recording processing of a disk identification signal are performed in simultaneous parallel. In composition shown in this drawing 10, the same composition as the finishing

device 60 mentioned above about drawing 7 attaches corresponding numerals, it is shown and duplicate explanation is omitted.
[0111]That is, the finishing device 80 is provided with the following in this embodiment.
The optical pickup 83A for precedence read-out.
The optical pickup 83B for record in which only predetermined time delays for it and scans a scanning locus which the optical pickup 83A for this precedence read-out scanned.

[0112]Thereby, the finishing device 80 processes regenerative-signal RF obtained from the optical pickup 83A for precedence read-out, detects a pit beyond periodic 9T, and records disk identification signal ED from the optical pickup 83B for record which carries out backward on the basis of this detection result further.
[0113]Namely, by the finishing device's 80 inputting the detection result NP of the or more [9] T pattern detecting circuit 62 into FIFO memory 84, carrying out a specified time lag, and supplying the modulation circuit 75, A time delay until the optical pickup 83B for record scans a scanning locus which the optical pickup 83A for precedence read-out scanned is compensated.
[0114]The system control circuit 82 is constituted by computer which controls operation of this finishing device 80, and makes a recording position of a disk identification signal seek the optical pickups 83A and 83B.
[0115]According to composition shown in drawing 10, in addition to the same effect as a 2nd embodiment, time which processing takes can be shortened by performing pit detection processing beyond periodic 9T, and additional recording processing of a disk identification signal in simultaneous parallel.
[0116](4) In other embodiments, in addition above-mentioned embodiments, although a case where membrane structure of CD-ROM was applied to a reflection seismogram side was described, this invention may apply membrane structure of a phase-change optical disk in addition to this, for example.
[0117]In [when estranging T or more / periodic 5 / and changing reflectance of an information storage side locally from edge of a pit in a 1st above-mentioned embodiment] 2nd and 3rd embodiments, Although attached and stated, without a case where estrange T or more [periodic 4] and reflectance of an information storage side is locally changed from edge of a pit, even if this invention is estranged T or more [periodic 3] and changes reflectance of an information storage side locally from edge of not only this but a pit, it can acquire same effect.
[0118]That is, when edge of a pit is approached and reflectance of an information storage side is changed locally, a jitter will occur in a regenerative signal. However, in a actual compact disc player, even if some jitter arises from a pit to a regenerative signal, a parenchyma top can reproduce data based on a pit sequence satisfactorily at all.
[0119]Let the minimum inversion intervals be three channel clocks by an EFM method currently used for abnormal conditions of a compact disk in relation with this jitter. This minimum inversion interval is specified as a distance which generating of a jitter by that change can almost disregard, even if

change of pits, such as a reflectance change, breaks out in a part which separated only this minimum inversion interval from edge of a pit. If additional recording of disk identification signal ED is carried out to a place which more than the minimum inversion interval separated from edge of a pit as for this, aggravation of a jitter by disk identification signal ED can be maintained to a value small enough, and data based on a pit sequence can be played certainly. Therefore, for example, if it is a compact disk, from edge of a pit, only distance corresponding to three channel clocks can be estranged, reflectance can be changed locally, and a disk identification signal can be recorded.

[0120]When estranging only distance corresponding to three channel clocks and recording a disk identification signal from edge of a pit in this way, a disk identification signal can be recorded on a pit and a land beyond periodic 7T.

[0121]Although a case where a disk identification signal was recorded on a pit beyond periodic 9T was described, it may be made to record this invention on a pit and a land not only this but beyond periodic 9T in 2nd and 3rd above-mentioned embodiments.

[0122]Although a case where estranged only the cycle 4T and a disk identification signal was recorded from edge by the side of a pit start was described, it may be made to record this invention in the center of each pit not only this but beyond periodic 9T in a pit beyond periodic 9T in 2nd and 3rd further above-mentioned embodiments.

[0123]moreover -- although a case where a disk identification signal was recorded on a sink frame portion which can be predicted was described in a 1st above-mentioned embodiment, if this invention can predict not only this but an appearing signal beforehand -- **** -- it is applicable also to a signal [like]. For example, when all or a part of signals recorded on a compact disk are known, it becomes possible to predict a pit sequence on a disk. Also in this case, it becomes possible to carry out additional recording of disk identification signal ED by applying this method, expecting a place fully distant from a portion of edge of a pit, and increasing a laser output momentarily at an expected place.

[0124]Although it is a pit more than predetermined length, and a land and a case where only 1 channel clock cycle changed reflectance of an information storage side locally was described in a further above-mentioned embodiment, If this invention estranges only prescribed distance from front edge and back edge in short not only in this and reflectance is changed selectively, By the ability to record a disk identification signal, without spoiling edge information, only a part of the central cycle 3T may change reflectance, for example about a pit and a land of the cycle 9T.

[0125]Although a case where a disk identification signal was recorded was described in an above-mentioned embodiment, This invention may record various data required for release of encryption, when recording digital audio signals enciphered not only by this but by a pit and land length, recording key information required for release of this encryption and recording data still more nearly required for selection of key information, and decoding.

[0126]Although a case where a disk identification signal was recorded was described in a finishing device of a compact disk in an above-mentioned embodiment, This invention is applied not only to this but to a compact disc player, for example, it may be made to record reproduction frequency of

data, and copy frequency according to a pit sequence.

[0127]Although a case where a data row of ** which carries out binary identification of the accumulated by an accumulator, and becomes with a disk identification signal was played was described, this invention carries out multiple-value discernment not only of this but this accumulated, and it may be made to play a data row of ** in a further above-mentioned embodiment.

[0128]In an above-mentioned embodiment, although a case where carried out eight-to-fourteen modulation and digital audio signals were recorded was described, this invention is widely applicable to various abnormal conditions, such as not only this but 1-7 abnormal conditions, 8-16, 2-7 abnormal conditions, etc.

[0129]In an above-mentioned embodiment, although a case where desired data was recorded by pit and a land was described, this invention can be widely applied, not only this but when recording desired data by mark and a space.

[0130]In an above-mentioned embodiment, although a case where an audio signal was recorded on a compact disk and its peripheral equipment with the application of this invention was described, this invention is widely applicable to various optical discs, such as not only this but a video disk, and peripheral equipment of those.

[0131]

[Effect of the Invention]According to this invention, as mentioned above to the timing which does not affect the position information on edge. Without affecting reproduction of the main data rows by a pit sequence etc. in any way by changing reflection films, such as a pit and a mark, locally, Copying refreshable depending on an illegal copy by the optical pickup which reproduces this main data row can record the data row of ** difficult.

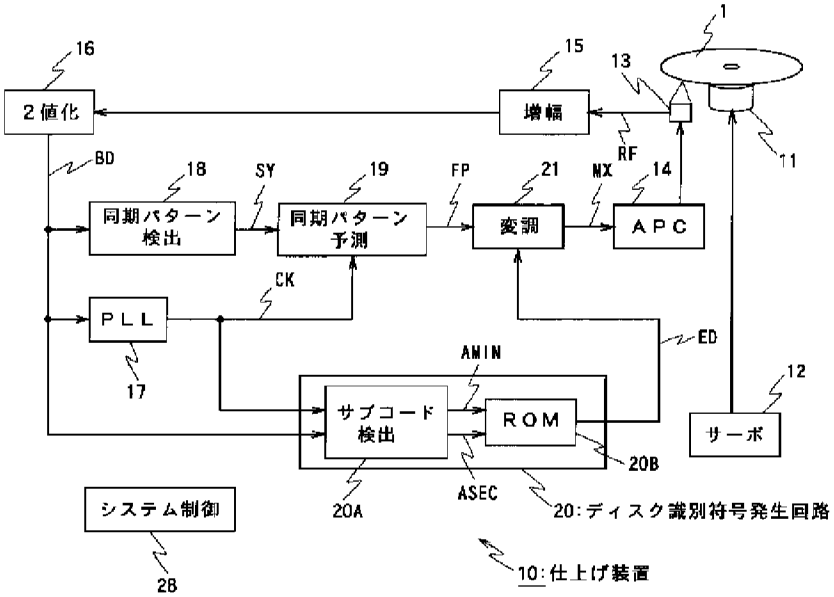
[Translation done.]

* NOTICES *

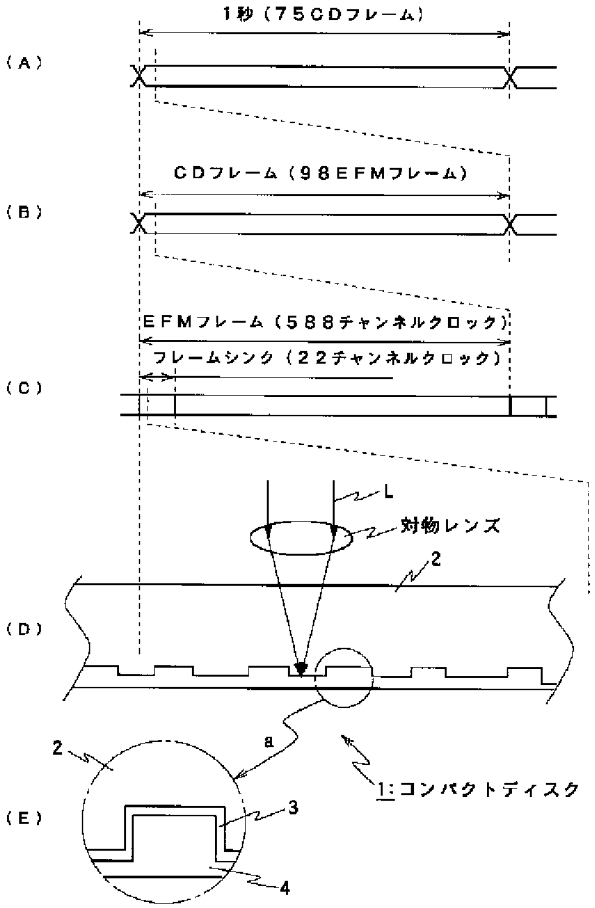
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

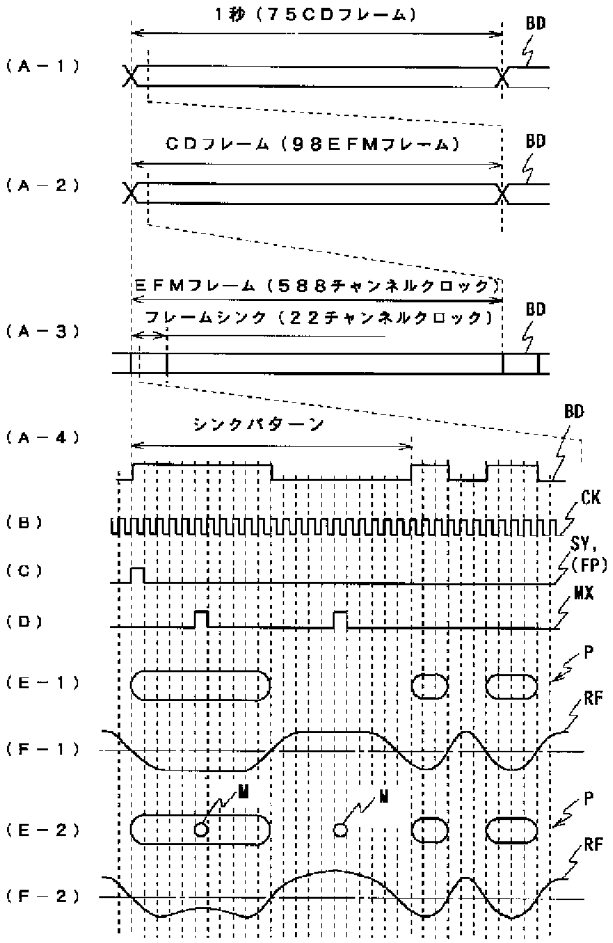
[Drawing 1]



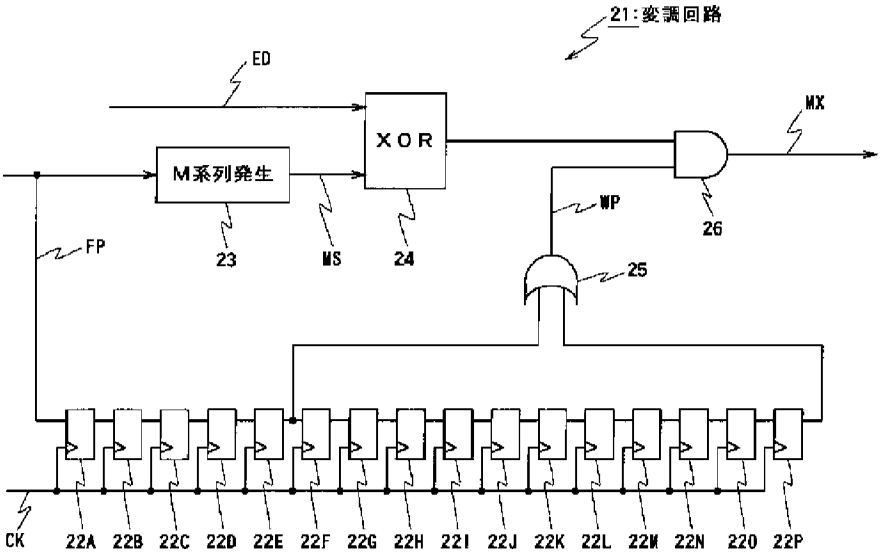
[Drawing 2]


1秒（75CDフレーム）
(A)
CDフレーム（98EFMフレーム）
(B)
EFMフレーム（588チャンネルクロック）
フレームシンク（22チャンネルクロック）
(C)
L
対物レンズ
2
(D)
a
2
1:コンパクトディスク
(E)
3
4

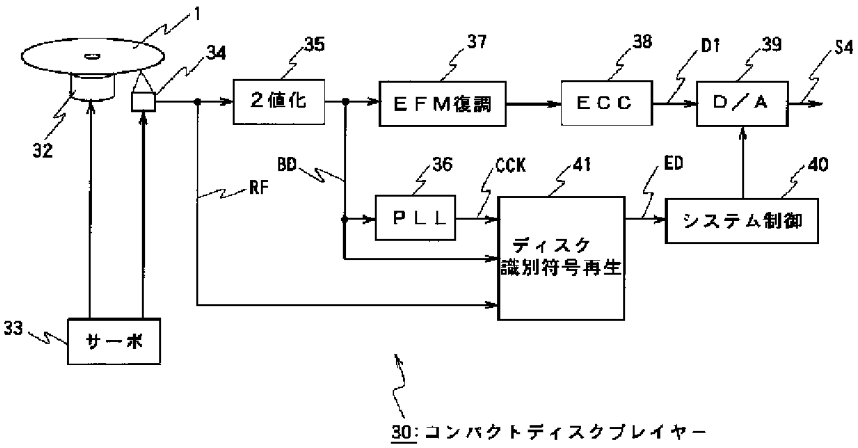
[Drawing 3]



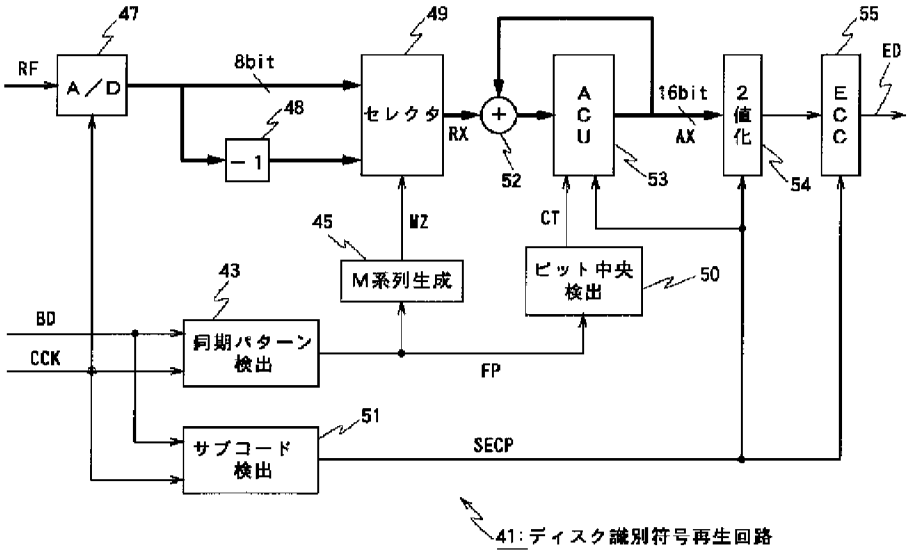
[Drawing 4]



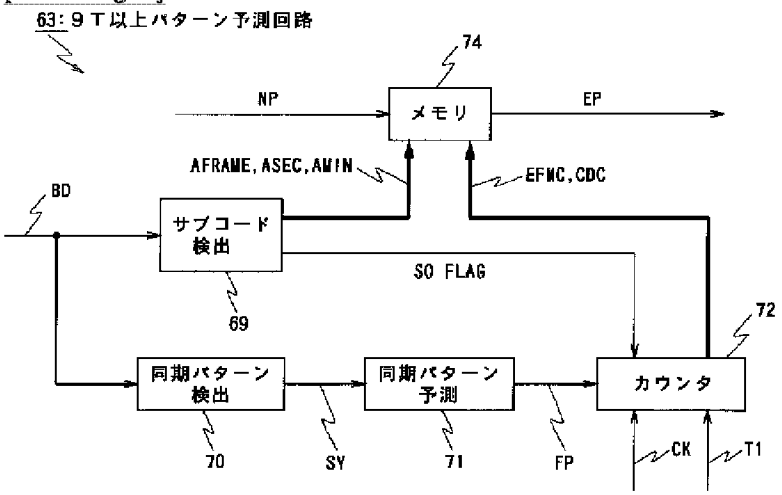
[Drawing 5]



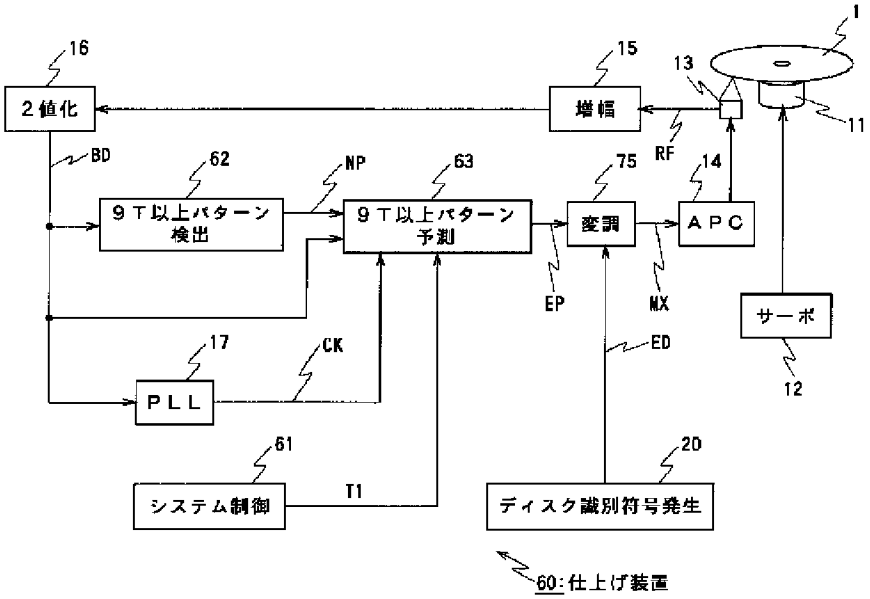
[Drawing 6]



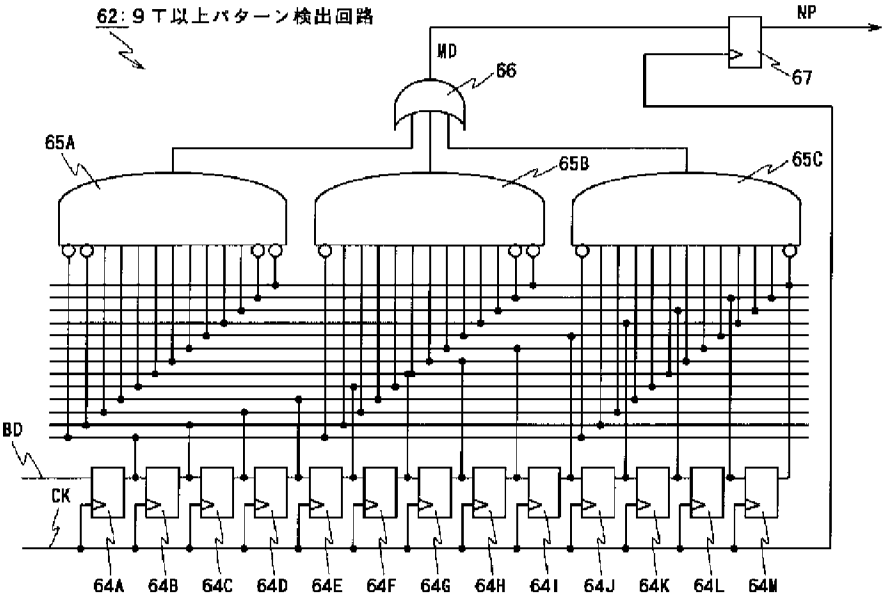
[Drawing 9]



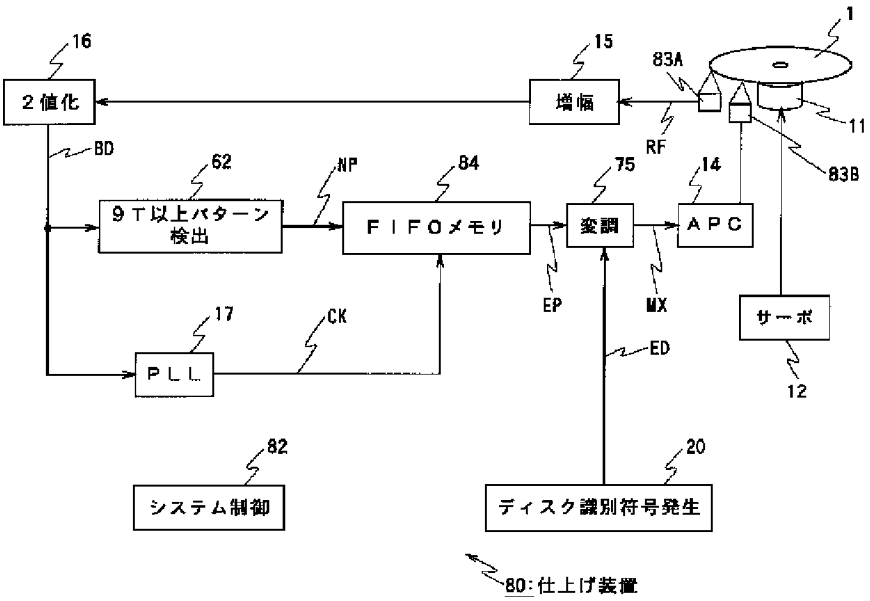
[Drawing 7]



[Drawing 8]



[Drawing 10]



[Translation done.]